PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C.20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

Date of mailing (day/month/year)
08 September 1999 (08.09.99)

International application No.
PCT/IB98/00999

Applicant's or agent's file reference
40699 PCT/RR

International filing date (day/month/year)
29 June 1998 (29.06.98)

Priority date (day/month/year)
30 June 1997 (30.06.97)

Applicant
CHORLEY, Brian et al

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

29 January 1999 (29.01.99)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer
Peggy Steunenberg

Telephone No.: (41-22) 338.83.38

Form PCT/IB/331 (July 1992)

2834728

Copy for the Elected Office (EO/US)

PCT/IB98/00999

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

To:

PLEVY, Arthur, L.
Buchanan Ingersoll P.C.
500 College Road East
Princeton, NJ 08540
ÉTATS-UNIS D'AMÉRIQUE

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

Date of mailing (day/month/year)
07 October 1999 (07.10.99)

Applicant's or agent's file reference
40699 PCT/RR

IMPORTANT NOTIFICATION

International application No.
PCT/IB98/00999

International filing date (day/month/year)
29 June 1998 (29.06.98)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address THE WHITAKER CORPORATION Suite 450 4550 New Linden Hill Road Wilmington, DE 19808 United States of America	State of Nationality US	State of Residence US
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☒ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address MEASUREMENT SPECIALTIES, INC. 80 Little Falls Road Fairfield, NJ 07004 United States of America	State of Nationality US	State of Residence US
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office
☐ the International Searching Authority
☒ the International Preliminary Examining Authority
☐ the designated Offices concerned
☒ the elected Offices concerned
☐ other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

S. Baharlou

Telephone No.: (41-22) 338.83.38

002887306

Form PCT/IB/306 (March 1994)

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

United States Patent and Trademark
Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 07 May 1999 (07.05.99)	
International application No. PCT/IB98/00999	**Applicant's or agent's file reference** 40699 PCT/RR
International filing date (day/month/year) 29 June 1998 (29.06.98)	**Priority date** (day/month/year) 30 June 1997 (30.06.97)
Applicant CHORLEY, Brian et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

03 February 1999 (03.02.99)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☐ was
☒ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland** Facsimile No.: (41-22) 740.14.35	Authorized officer S. Baharlou Telephone No.: (41-22) 338.83.38

Copy for the Elected Office (EO/US)

PCT/IB98/00999

P ENT COOPERATION TREA

From the INTERNATIONAL BUREAU

To:

PLEVY, Arthur, L.
Buchanan Ingersoll P.C.
500 College Road East
Princeton, NJ 08540
ÉTATS-UNIS D'AMÉRIQUE

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

Date of mailing (day/month/year)
07 October 1999 (07.10.99)

Applicant's or agent's file reference
40699 PCT/RR

IMPORTANT NOTIFICATION

International application No.
PCT/IB98/00999

International filing date (day/month/year)
29 June 1998 (29.06.98)

1. The following indications appeared on record concerning:
☐ the applicant ☐ the inventor ☒ the agent ☐ the common representative

Name and Address
PLEVY, Arthur, L.
Greenbaum, Rowe, Smith, Ravin,
Davis & Himmel, LLP
Metro Corporate Campus I
P.O. Box 5600
Woodbridge, NJ 07095
United States of America

State of Nationality
State of Residence
Telephone No.
Facsimile No.
Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:
☐ the person ☐ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address
PLEVY, Arthur, L.
Buchanan Ingersoll P.C.
500 College Road East
Princeton, NJ 08540
United States of America

State of Nationality
State of Residence
Telephone No.
Facsimile No.
Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:
☒ the receiving Office
☐ the International Searching Authority
☒ the International Preliminary Examining Authority
☐ the designated Offices concerned
☒ the elected Offices concerned
☐ other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

Authorized officer
S. Baharlou
Telephone No.: (41-22) 338.83.38

002887236

Form PCT/IB/306 (March 1994)

INTERNATIONAL SEARCH REPORT

Int[illegible]ional Application No
P[illegible]/IB 96/00782

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 G06K7/08 G06K19/10 G07D7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G06K G07D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 166 273 A (GAO GES AUTOMATION ORG) 2 January 1986 see page 3, line 3 - page 4, line 23 see page 9, line 4 - page 11, line 4; figures 1-4	1-4,8, 10,14-16
A	US 4 792 667 A (CHEN DANIEL Y-J) 20 December 1988 cited in the application see the whole document	1,14
A	WO 94 20932 A (AUTHENTICATION TECHNOLOGIES IN) 15 September 1994 see claim 1; figures 1-7	1,10,14

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

1

Date of the actual completion of the international search 22 November 1996	Date of mailing of the international search report 09. 12. 96
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Authorized officer Gysen, L

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
P[illegible]T/IB 96/00782

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0166273	02-01-86	DE-A- 3421041	12-12-85
		DE-A- 3584914	30-01-92
		JP-B- 6073998	21-09-94
		JP-A- 61059589	27-03-86
		JP-A- 6236474	23-08-94
		US-A- 4763927	16-08-88
US-A-4792667	20-12-88	NONE	
WO-A-9420932	15-09-94	US-A- 5394969	07-03-95
		AU-A- 4790993	26-09-94

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 40699 PCT/RR	**FOR FURTHER ACTION** see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/IB 98/00999	International filing date *(day/month/year)* 29/06/1998	(Earliest) Priority Date *(day/month/year)* 30/06/1997
Applicant THE WHITAKER CORPORATION et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ **Certain claims were found unsearchable** (see Box I).

2. ☐ **Unity of invention is lacking** (see Box II).

3. ☐ The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing
   - ☐ filed with the international application.
   - ☐ furnished by the applicant separately from the international application,
     - ☐ but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.
   - ☐ Transcribed by this Authority

4. With regard to the **title**,
   - ☒ the text is approved as submitted by the applicant
   - ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,
   - ☒ the text is approved as submitted by the applicant
   - ☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is:

   Figure No. 2
   - ☒ as suggested by the applicant.
   - ☐ because the applicant failed to suggest a figure.
   - ☐ because this figure better characterizes the invention.
   - ☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
P[illegible]/IB 98/00999

A. CLASSIFICATION OF SUBJECT MAT[illegible]
IPC 6 B42D15/00

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B42D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 566 982 A (LEHUREAU ET AL) 22 October 1996 see the whole document ---	1
A	WO 97 07478 A (THE WHITAKER CORPORATION) 27 February 1997 see the whole document -----	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search 24 September 1998	Date of mailing of the international search report 05/10/1998
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Evans, A

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
P[illegible]IB 98/00999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5566982 A	22-10-1996	FR 2707781 A EP 0634732 A	20-01-1995 18-01-1995
WO 9707478 A	27-02-1997	EP 0845127 A	03-06-1998

PCT

D INTELLECTUAL PROPERTY ORGANIZATIO
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
B42D 15/00

A1

(11) International Publication Number: WO 99/01292

(43) International Publication Date: 14 January 1999 (14.01.99)

(21) International Application Number: PCT/IB98/00999

(22) International Filing Date: 29 June 1998 (29.06.98)

(30) Priority Data:
9713850.7 30 June 1997 (30.06.97) GB

(71) Applicants *(for all designated States except US)*: THE WHITAKER CORPORATION [US/US]; Suite 450, 4550 New Linden Hill Road, Wilmington, DE 19808 (US). THE GOVERNOR AND COMPANY OF THE BANK OF ENGLAND [GB/GB]; Threadneedle Street, London EC2R 8AH (GB).

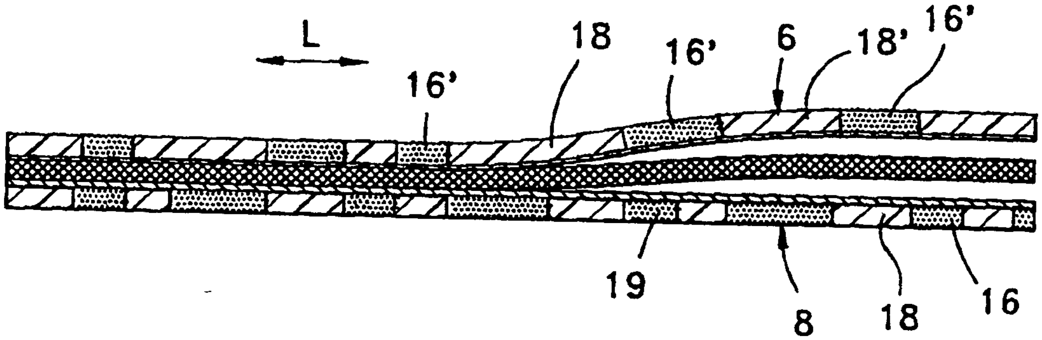
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: CHORLEY, Brian [GB/GB]; 17 Westbury Lane, Buckhurst Hill, Essex IG9 5NF (GB). BROWN, Richard, Hunter [GB/DE]; Zum Röhrbrunnen 8, D-63303 Dreieich-Offenthal (DE). YASKOWSKI, Joseph, Francis [US/US]; 1713 Dell Road, P.O. Box 126, Fairview Village, PA 19409-126 (US).

(74) Agents: REUTELER, Raymond, Werner et al.; AMP International Enterprises Ltd., AMPèrestrasse 3, CH-9323 Steinach (CH).

(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: SECURITY THREAD



(57) Abstract

A security thread (2), for identification of security documents such as banknotes, has a magnetic layer (4) sandwiched between polymeric layers (6, 8), where one of the layers (8) is a piezoelectric layer such as PVDF. The piezoelectric layer (8) may be poled intermittently such the piezoelectric layer is coded. A particularly compact security thread with enhanced multiple coded features is thus provided.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania
AM	Armenia
AT	Austria
AU	Australia
AZ	Azerbaijan
BA	Bosnia and Herzegovina
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
BY	Belarus
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CN	China
CU	Cuba
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GE	Georgia
GH	Ghana
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IL	Israel
IS	Iceland
IT	Italy
JP	Japan
KE	Kenya
KG	Kyrgyzstan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakstan
LC	Saint Lucia
LI	Liechtenstein
LK	Sri Lanka
LR	Liberia
LS	Lesotho
LT	Lithuania
LU	Luxembourg
LV	Latvia
MC	Monaco
MD	Republic of Moldova
MG	Madagascar
MK	The former Yugoslav Republic of Macedonia
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
MX	Mexico
NE	Niger
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SG	Singapore
SI	Slovenia
SK	Slovakia
SN	Senegal
SZ	Swaziland
TD	Chad
TG	Togo
TJ	Tajikistan
TM	Turkmenistan
TR	Turkey
TT	Trinidad and Tobago
UA	Ukraine
UG	Uganda
US	United States of America
UZ	Uzbekistan
VN	Viet Nam
YU	Yugoslavia
ZW	Zimbabwe

SECURITY THREAD

This invention relates to a security thread for protecting documents, banknotes, or identification cards against forgery.

In banknotes, it is common to find security threads in the form of thin strips imbedded in paper, such strips of a magnetic material provided with magnetic coding. The strip may be provided with a metallised layer either side of the magnetic material, the metallisation also used to print fine characters as a further security feature. As mechanical support and protection, the magnetic material and metallisation layers are sandwiched between plastic (polyester) layers.

It is also known to provide piezoelectric film in security documents as described in US 4,763,927 or US 4,792,667, the presence of piezoelectric material being detectable by mechanical or pyroelectric testing means. In US 4,792,667, pre-poled films of polymeric material made from polyvinylidene fluoride (PVDF) or other polymeric piezoelectric materials are fixed to documents for security. Piezoelectric films with poled regions may not provide sufficient security for certain documents such as banknotes.

It would be desirable to further enhance the security against forgery of security threads. It would also be advantageous to provide additional features in a security thread that enable easy detection or that provide a redundant control in the event the primary security feature is defective. It is desirable to provide security means that are well adapted for manufacture in large quantities, and which are cost-effective to manufacture whilst enhancing security against forgery, reliability, and ease of detection.

It is an object of this invention to provide an improved security thread with enhanced security against forgery and ease of detection.

Objects of this invention have been achieved by providing the security thread according to claim 1. Disclosed herein is a security thread comprising a magnetic layer sandwiched between protective layers, wherein at least one of the protective layers is a piezoelectric polymer. Advantageously therefore, a particularly compact and cost-effective security thread is provided with enhanced security features. The magnetic material may be coded as is typical for conventional security threads, wherein the piezoelectric polymer layer may also have a series of juxtaposed poled and unpoled regions. The poled and unpoled regions may form a binary code such that both the magnetic and the piezoelectric layers have coding means; the magnetic layer being readable by a magnetic head, and the piezoelectric layer readable by a conductor or capacitive receptor after stimulation of the piezoelectric poled regions by mechanical (e.g. ultrasound) or pyroelectric (e.g. infrared rays) transmitters. On either side of the magnetic layer, there may be provided a metallisation layer, one of the metallisation layers thus being sandwiched between the magnetic layer and the piezoelectric layer and forming an electrode for the piezoelectric poled regions, in particular forming the ground electrode. The metal layer is reflective to light thereby concealing the magnetic layer, and forms a base for printing characters that can be read when light is passed through the metallisation layer. Compound security measures can thus be provided in a particularly compact security thread, requiring various detection means that enhances security against forgery.

Further advantageous aspects of the invention are set forth in the claims, or will be apparent from the following description and drawings.

Embodiments of this invention will now be described by way of example, with reference to the figures in which;

Figure 1 is a cross-sectional view through a security thread according to this invention, the thread shown partially laminated;

Figure 2 is a view similar to Figure 1 different embodiment according to this invention.

Figure 3 is a simple schematic view representing dipoles in a portion of piezoelectric layer taken in cross-section; and

Figure 4 is a simple schematic view illustrating how a piezoelectric layer is polarised.

Referring to Figure 1, a security thread 2 is shown in longitudinal cross-section. The security thread may be of substantially similar shape and dimension as a conventional security thread embedded in banknotes or security documents, for example in the form of a thin elongate thread traversing a banknote. The security thread 2 comprises a magnetic layer 4 sandwiched between polymeric layers 6, 8 either side of the magnetic layer 4. The polymeric layers 6, 8 may be of different materials, for example a first layer 6 being of simple polyester or other flexible plastic material, and the second layer 8 being of a piezoelectric material such as polyvinyldene fluoride (PVDF) or other piezo electric polymeric material. It is also possible to provide the second layer 8 as a simple flexible plastic layer such as polyester, coded or printed on one side thereof with a piezoelectric material such as polymer(VDF/TrVE) or vinylidene/tetrafluoritheylene co-polymer (VDF/TFE).

The flexible polymeric layers 6, 8 are also protective layers that support and protect the magnetic layer 4 therebetween from mechanical damage. The magnetic layer 4 may be coded magnetically along its length (direction L) such that each security thread has a distinctive magnetic code readable by a detection device having a magnetic head. The magnetic layer 4 is shown in Figures 1 and 2 as a layer separately laminated between the polymeric layers 6, 8, but the magnetic layer may also be printed or deposited otherwise on one of the polymeric support layers 6, 8, for example the simple polymeric (polyester) layer 6. The polymeric layer 6 with the deposited magnetic layer 4 would then bonded to the other polymeric layer 8 by means of a conventional adhesive.

A metallisation layer 10 is provided between the magnetic layer 4 and the piezoelectric layer 8. The metallisation layer 10 may be deposited on the piezoelectric layer 8 by sputtering or other conventional metal deposition methods for deposing metals on substrates or the like. The metallisation may also be etched in certain places to form characters that are readable when light is shone through the security thread. The electrode 10 further acts as a ground electrode for contacting an inner side 11 of the piezoelectric layer 8 to ground, the opposing other side 12 of the piezoelectric layer 8 being readable by a detection device, for example a conductive member biased thereagainst. When subject to mechanical deformation, piezoelectric material produces electrical charges, an electrical potential thus being developed between the inner and outer layers 11, 12. The electrical charge that develops can either be read by an electrical detector connected to the ground electrode 10 and the charge

electrode layer 12, or by capacitive detection means that responds to the electrical field created by the electrical charges. Piezoelectric materials such as PVDF also have a pyroelectric effect, whereby when subject to heat (for example from a light source emitting infrared) the heating of the piezoelectric creates an electric potential between the opposed layers 11, 12. Detection of the pyroelectric effect may for example be effected by the detection device described in International Application WO 97/07478.

As shown in Figure 1, the polymeric layer 6 may also be provided with a metallisation layer 14 on its inner side 15. This metallisation layer may similarly be provided with characters.

In the embodiment of Figure 1, the piezoelectric layer 8 is substantially uniformly charged (poled) piezoelectrically along the whole length thereof. As illustrated in Figure 2, in a second embodiment the piezoelectric layer 8 is provided with a series of poled regions 16 and unpoled regions 18. The poled and unpoled regions may have lengths that are multiples of a smallest bit length, as depicted in Figure 2 by the poled region 19, such that the piezoelectric layer 8 has a binary code extending along its length L. By mechanical excitation such as ultrasound, a conductive or capacitive detector can pick up the electrically charged areas along the length, thereby reading the binary code.

It is also possible to charge piezoelectric material such as PVDF, either negatively or positively such that certain of the poled regions are positive and certain of the poled regions are negative. In this way, it is also possible to provide a tertiary code rather than a binary code. The latter is illustrated in Figure 4 which schematically illustrates the dipole orientation in a

portion of polymeric piezoelectric layer. The horizontal dipoles 20 indicate a non-piezoelectric area and the vertical dipoles 21, 22 represent respectively negative and positively poled areas.

The coded piezoelectric layer 8 of the embodiment of Figure 2 can be made by positioning a ground electrode 24 against one side of the layer 8 (for example the metallised ground layer 10) and positioning charge electrodes 26 on the charge side 12 of the layer 8. The charge electrodes 26 may be provided with a high positive or negative voltage depending on whether positive poled regions or negative poled regions are desired. The charge electrodes 26 may be held together in a single structure, with a dieletric (such as a ceramic or air) separating the poling regions. The electrodes may be provided on a rotating drum, the grounded electrode forming a opposed rotating drum with the piezoelectric layer sandwiched therebetween such that a continuous lamination of the piezoelectric layer 8 with piezoelectric poling can be effected.

As illustrated in Figure 2, the first polymeric layer 6 may also be a piezoelectric layer, for example charged with a binary code that may either differ from the binary code of the layer 8 as indicated by the piezoelectric charged regions 16′ and immediate non-charged regions 18′. It is also possible to provide the first layer 6 with the same binary code as the second layer 8 to enhance the reliability in the event one of the layers is defective. The second metallisation layer 14 could also act as the ground electrode for the piezoelectric layer 6 in a similar manner to the ground electrode for the piezoelectric layer 8.

A particularly compact security thread with enhanced security is thus provided. The means of detecting the

security thread based on different physical effects such as the magnetic field of the magnetic layer 4 and the electrical field or potential differences of the piezoelectric layer or layers 6, 8, significantly increases difficulty of forgery.

CLAIMS

1. A security thread comprising a magnetic layer sandwiched between protective layers, wherein at least one of the protective layers comprises a piezoelectric polymer.

2. The security thread of claim 1 wherein the piezoelectric polymer layer has poled and unpoled regions forming a binary or tertiary code.

3. The security thread of claim 1 or 2 wherein a pair of the protective layers, one either side of the magnetic layer, is a piezoelectric polymer.

4. The security thread of claim 3 wherein each of the piezoelectric layers has poled and unpoled regions.

5. The security thread of any one of the preceding claims wherein the thread further comprises a metallisation layer between the piezoelectric polymer layer and the magnetic layer.

6. The security thread of claim 5 wherein the metallisation layer acts as a ground electrode for the piezoelectric layer.

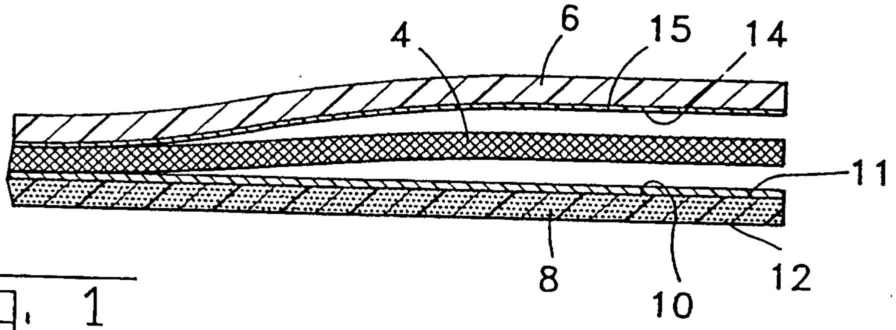


Fig. 1

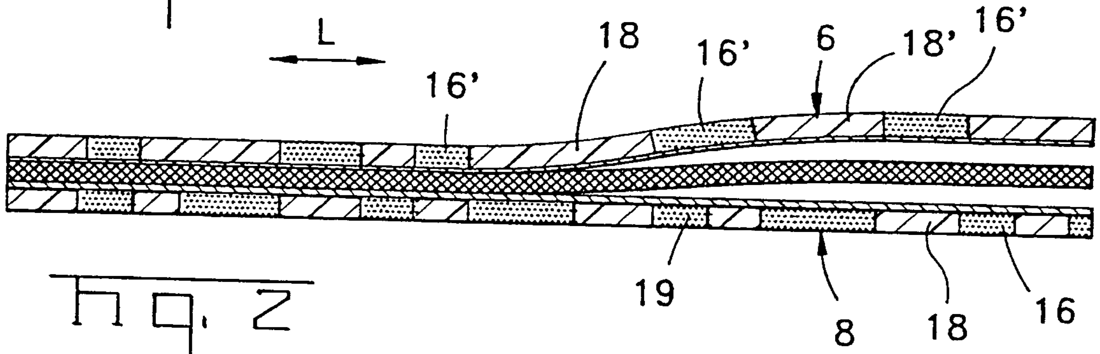


Fig. 2

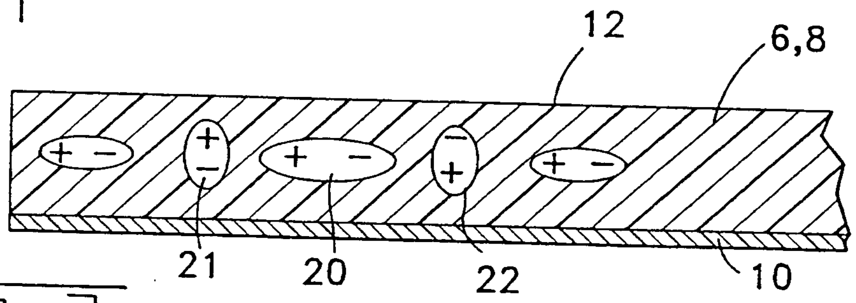


Fig. 3

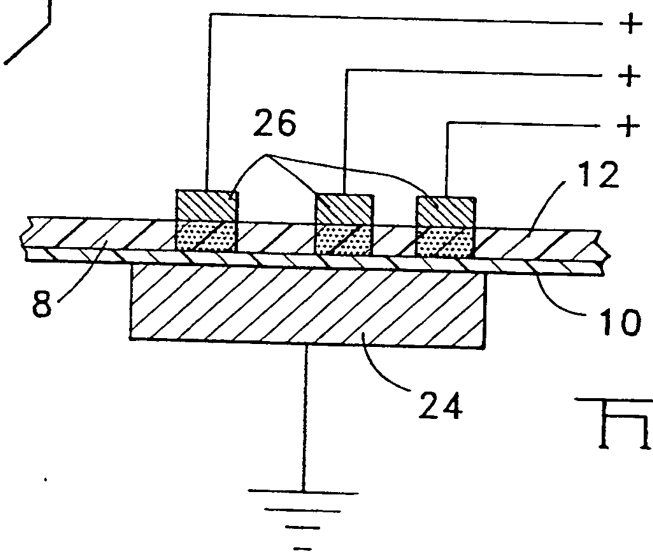


Fig. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 96/00782

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G06K7/08 G06K19/10 G07D7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G06K G07D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 166 273 A (GAO GES AUTOMATION ORG) 2 January 1986 see page 3, line 3 - page 4, line 23 see page 9, line 4 - page 11, line 4; figures 1-4 ---	1-4,8, 10,14-16
A	US 4 792 667 A (CHEN DANIEL Y-J) 20 December 1988 cited in the application see the whole document ---	1,14
A	WO 94 20932 A (AUTHENTICATION TECHNOLOGIES IN) 15 September 1994 see claim 1; figures 1-7 -----	1,10,14

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search 22 November 1996	Date of mailing of the international search report 09. 12. 96
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Authorized officer Gysen, L

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int ional Application No
F. i/IB 96/00782

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0166273	02-01-86	DE-A- 3421041	12-12-85
		DE-A- 3584914	30-01-92
		JP-B- 6073998	21-09-94
		JP-A- 61059589	27-03-86
		JP-A- 6236474	23-08-94
		US-A- 4763927	16-08-88
US-A-4792667	20-12-88	NONE	
WO-A-9420932	15-09-94	US-A- 5394969	07-03-95
		AU-A- 4790993	26-09-94

A·D

REC'D 16 DEC 1999	
WIPO	PCT

17

ENT COOPERATION TRE

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference MSI	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/IB98/00999	International filing date *(day/month/year)* 29/06/1998	Priority date *(day/month/year)* 30/06/1997

International Patent Classification (IPC) or national classification and IPC
B42D15/00

Applicant
MEASUREMENT SPECIALTIES INC., et al.

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   I ☒ Basis of the report
   II ☐ Priority
   III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   IV ☐ Lack of unity of invention
   V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   VI ☐ Certain documents cited
   VII ☒ Certain defects in the international application
   VIII ☐ Certain observations on the international application

Date of submission of the demand 29/01/1999	Date of completion of this report 14. 12. 99
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Louka, M Telephone No. +49 89 2399 2388

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB98/00999

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-7	as originally filed

Claims, No.:

1-6	as originally filed

Drawings, sheets:

1/1	as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description,	pages:
☐ the claims,	Nos.:
☐ the drawings,	sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-6
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-6
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-6
	No:	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Section V

Claim 1

According to page 1, lines 6-14, a security thread comprising a magnetic layer sandwiched between two protective plastic layers is known from the prior art.
The subject-matter of claim 1 differs from the known security thread in that at least one of the protective layers comprises a piezoelectric polymer.
This distinguishing feature solves to problem of enhanced security against forgery and ease of detection.
The at least one piezoelectric polymeric layer permits the detection of the electric field or potential differences formed therein and hence increases the difficulty of forgery, when only the magnetic field of the magnetic layer is detected.
None of the available prior art documents discloses or suggests the addition of a piezoelectric polymer to the plastic protective layers known from the prior art.
The subject-matter of claim 1 is therefore fulfilling the requirements of Art. 33 (2), (3) PCT.

Claims 2-6

The additional features of these claims are only preferred embodiments of the invention specified in claim 1 and as such, they also fulfill the requirements of Art. 33 (2), (3) PCT.

Section VII

The features of the claims have not been provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Independent claim 1 has not been drafted in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would have been appropriate, with those features known in combination from the prior art (see page 1, lines 6-14) being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

INTERNATIONAL SEARCH REPORT

Int[illegible]tional Application No
PC[illegible]B 98/00999

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B42D15/00

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B42D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 566 982 A (LEHUREAU ET AL) 22 October 1996 see the whole document ---	1
A	WO 97 07478 A (THE WHITAKER CORPORATION) 27 February 1997 see the whole document -----	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search 24 September 1998	Date of mailing of the international search report 05/10/1998
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Evans, A

INTERNATIONAL SEARCH REPORT

Informa[illegible]n patent family members

In[illegible]ional Application No
PC[illegible] 98/00999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5566982 A	22-10-1996	FR 2707781 A EP 0634732 A	20-01-1995 18-01-1995
WO 9707478 A	27-02-1997	EP 0845127 A	03-06-1998